CHE 107 Final Exam A Summer 2015 - Confidential

Exam ID: 70   **Course Name:** -

Current Date and Time: Mon, Aug 10, 2015 @ 14:58:27 EDT

Total Exam Points: 26.00

Question #: 1

If a solid line represents a covalent bond and a dotted line represents an intermolecular attraction, which of the following shows a strong **hydrogen bond**? Select **all** that apply.

    A.   —C·····H—C—
    B.   —N·····H—N—
    C.   —F·····H—F
   D.   —Cl·····H—Cl

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Question #: 2

The resistance of a liquid to flow is _____, which _____ decreasing strength of intermolecular forces.

    A. viscosity; increases with
    B. viscosity; decreases with
    C. surface tension; increases with
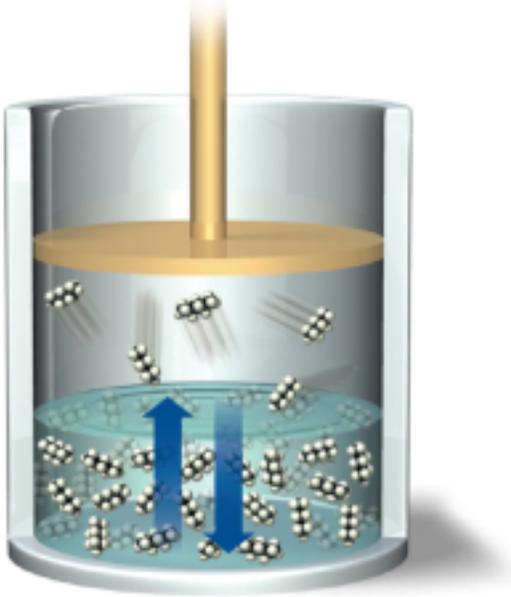   D. surface tension; is independent of

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Question #: 3

A state of dynamic equilibrium is reached when the rate of condensation _____ the rate of vaporization. Which choice below correctly fills in the blank and gives an example of dynamic equilibrium?
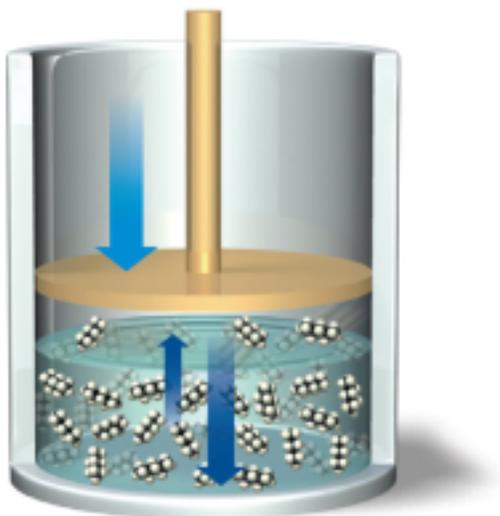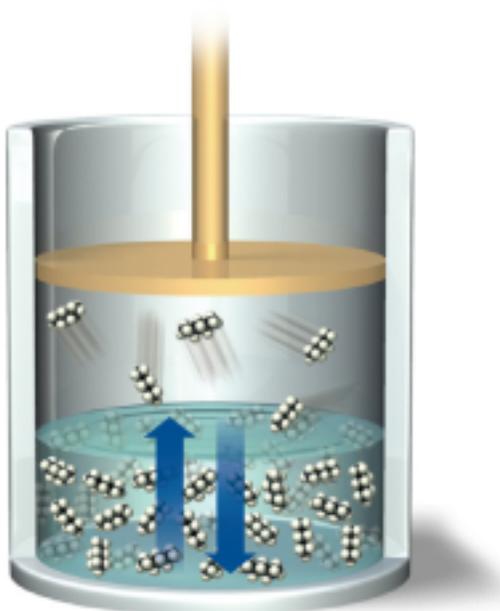
A. equals;
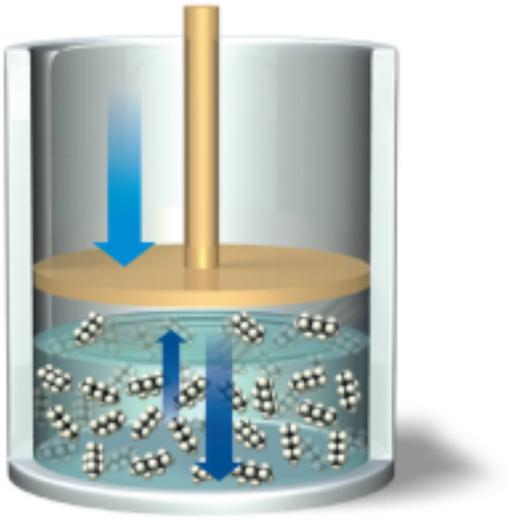
B. is greater than;

C. is less than;

D. equals;

Question #: 4

Levomenthol, $C_{10}H_{20}O$, has a normal boiling point of 212 °C. If the temperature is increased to 232 °C, what will happen to the vapor pressure of levomenthol?

    A. The vapor pressure will increase.

    B. The vapor pressure will decrease.

C. The vapor pressure will remain constant.

Question #: 5

How much energy is required to warm 36.0 g (2.00 mol) of $H_2O(l)$, initially at 0.0 °C, to $H_2O(g)$ at 100.0 °C?

melting point = 0.00 °C
boiling point = 100.0 °C
ΔH_{fus} = 6.02 kJ/mol
ΔH_{vap} = 40.7 kJ/mol
C_s of $H_2O(s)$ = 2.09 J/g °C
C_s of $H_2O(l)$ = 4.18 J/g °C
C_s of $H_2O(g)$ = 2.01 J/g °C

  A. 14,100 kJ
  B. 108 kJ
  C. 71.8 kJ
  D. 96.4 kJ

Question #: 6

Name the indicated points on the phase diagram.
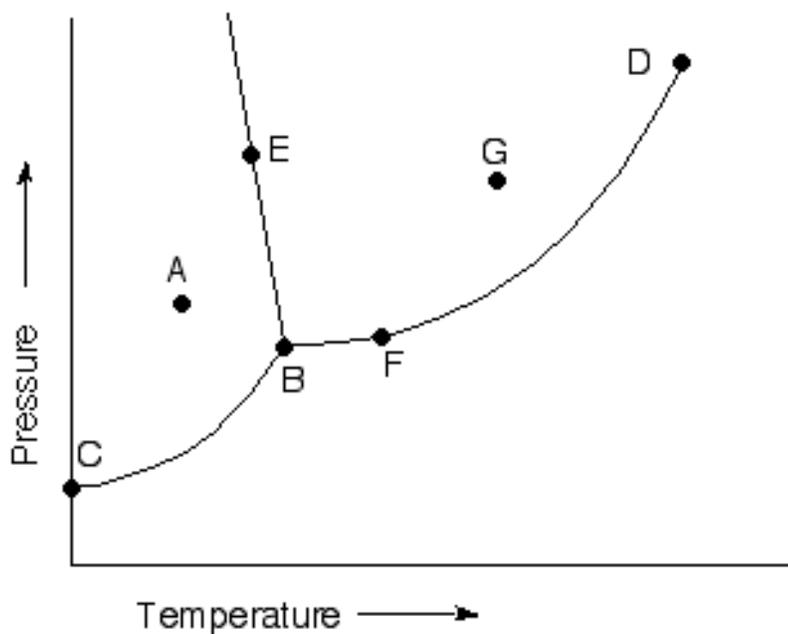
Point D is the ____ [critical, triple] point.

Point A is located in the ____ [solid, liquid, gas] region.

Point F is located on the ____ [fusion, vaporization, sublimation] curve.

1. critical|crit|critic|
2. solid|sol|s|
3. vaporization|vapor|

Determine the ionic formula for lead zirconate, using the unit cell depicted below. The oxide ions (gray circles) are on each face, the lead ions (white circles) are on each cell corner, and the zirconium ion (smallest, black circle) is in the center.
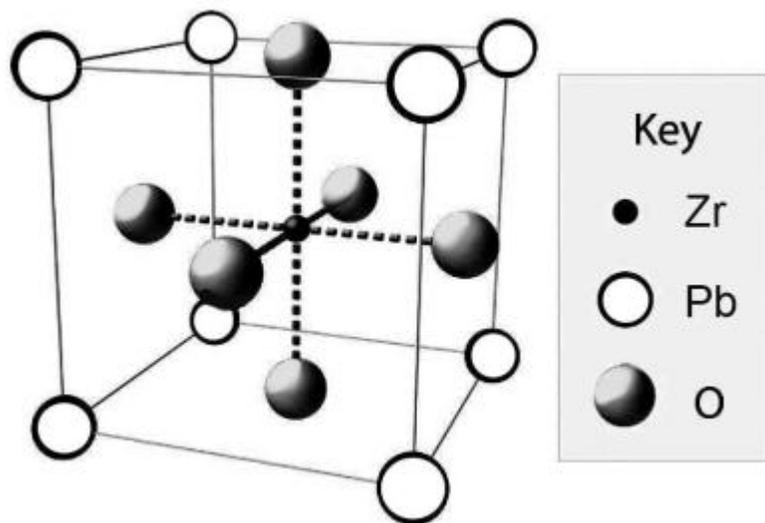
A. PbZrO3

B. PbZr$_2$O$_3$

C. Pb4ZrO$_3$

D. Pb$_8$ZrO$_6$

The liquids CCl_4 and C_6H_6

A. are not miscible because they cannot form hydrogen bonds with one another.
B. are not miscible because they are not identical, so the intermolecular interactions in the liquids are not of similar type and magnitude.
C. are miscible because they are both polar molecules.
D. are miscible because intermolecular interactions in the liquids are of similar type and magnitude.

Question #: 9

An unstable solution in which more than the equilibrium amount of solute is dissolved is a(n) _____ solution.

A. unsaturated
B. saturated
C. supersaturated
D. supercritical

Question #: 10

What is the molality of a solution prepared by dissolving 23.5 g ethylene glycol ($C_2H_6O_2$, 62.07 g/mol) in 750. g of water?

A. 30.2 m
B. 2.60 m
C. 0.306 m
   m

Question #: 11

How many moles of fluoride (19.00 g/mol) are found in a 10.00 g water sample that is 1.00 ppm by mass fluoride?

A. 7.72×10^{-6} mol
B. 4.15×10^{-4} mol
C. 1.28×10^{-11} mol

D. 5.26 × 10−7 mol

What is the **molality** of a 1.25 M HCl (36.46 g/mol) solution with a density of 1.017 g/mL?

    A. 1.39 m
    B. 1.19 m
    C. 1.29 m
    D. 1.09 m

Which solution has the **highest** freezing point?

    A. 1.0 m $AlCl_3$
    B. 1.0 m NaF
    C. 1.0 m C6H12O6 (glucose)
    D. 1.0 m Na_2SO_4

Given the reaction 2 $C_2H_2(g)$ + 5 $O_2(g)$ → 4 $CO_2(g)$ + 2 $H_2O(g)$, select the correct expression of the rate law.

A.

$$Rate = 5\frac{\Delta[O_2]}{\Delta t}$$

B.
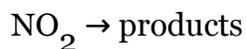
$$Rate = -\frac{1}{2}\frac{\Delta[C_2H_2]}{\Delta t}$$

C.

$$Rate = -\frac{1}{4}\frac{\Delta[CO_2]}{\Delta t}$$

D.

$$Rate = \frac{\Delta[H_2O]}{\Delta t}$$
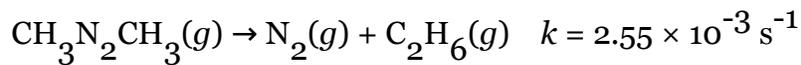

Question #: 15

The rate law for the reaction

$NO_2 \rightarrow$ products

has the form

rate $= k[NO_2]^n$

When [NO2] is doubled, the reaction rate increases by a factor of four. The exponent $n =$ _____.

Question #: 16

The decomposition of azomethane, $CH_3N_2CH_3$, at 300 °C follows first-order kinetics. How long must the reaction run for the final concentration of azomethane to decrease to 1/8 of the initial concentration?

$$CH_3N_2CH_3(g) \rightarrow N_2(g) + C_2H_6(g) \quad k = 2.55 \times 10^{-3}\ s^{-1}$$

A. 492 seconds
B. 652 seconds
C. 961 seconds
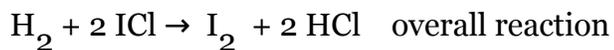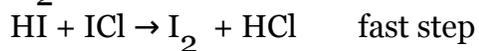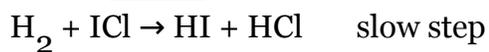D. 815 seconds

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Question #: 17

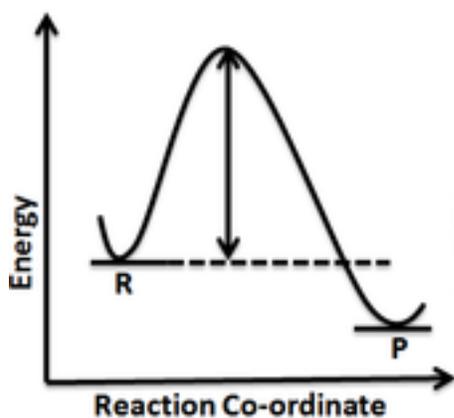What effect does doubling the Kelvin temperature of a reaction mixture have on the rate constant, k?

A. The value of the rate constant doubles.

B. The value of the rate constant increases, but not necessarily doubles.

C. The value of the rate constant decreases by half.

D. The value of the rate constant decreases, but not necessarily by half.
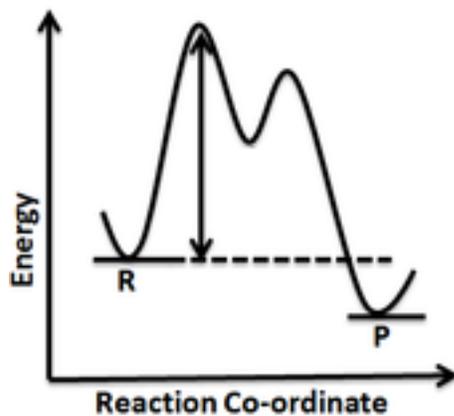

Question #: 18

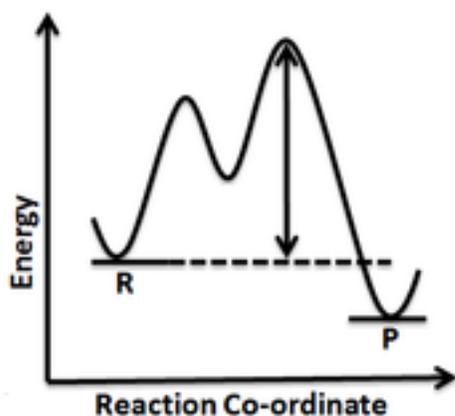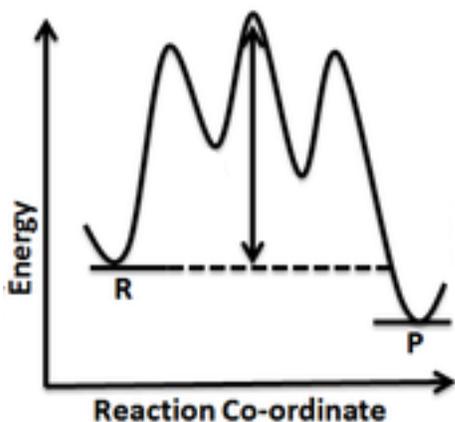Which **graph** best describes the reaction below?

H_2 + ICl → HI + HCl   slow step

HI + ICl → I_2 + HCl   fast step

H_2 + 2 ICl → I_2 + 2 HCl   overall reaction

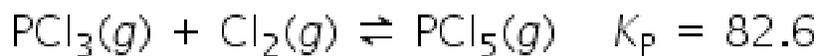A.

B.

C.

Reaction Co-ordinate

D.

Reaction Co-ordinate

Question #: 19

Initially, 0.50 atm each of $PCl_3(g)$ and $Cl_2(g)$ is added to a reaction vessel. Given the balanced chemical equation and K_P, what is true about the **equilibrium** concentrations of reactants and products?

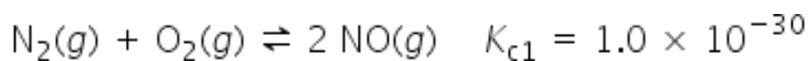$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g) \quad K_P = 82.6$$

The equilibrium lies to the _____, so the concentrations of PCl_3 and Cl_2 will be significantly _____ than the concentration of PCl_5.
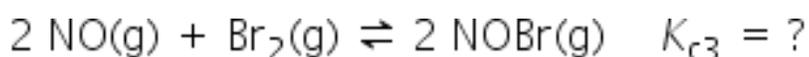
A. right; higher
B. right; lower
C. left; lower
D. left; higher

Given

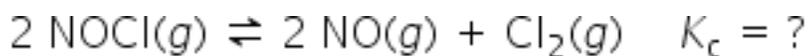$$N_2(g) + O_2(g) \rightleftharpoons 2\,NO(g) \quad K_{c1} = 1.0 \times 10^{-30}$$

$$N_2(g) + O_2(g) + Br_2(g) \rightleftharpoons 2\,NOBr(g) \quad K_{c2} = 2.0 \times 10^{-27}$$

what is the value of K_{c3} for

$$2\,NO(g) + Br_2(g) \rightleftharpoons 2\,NOBr(g) \quad K_{c3} = ?$$

    A. 2.0×10^3
    B. 5.0×10^5
    C. 2.0×10^{-6}
    D. 5.0×10^{-58}

A reaction vessel is charged with NOCl(g) at 800 °C and allowed to come to equilibrium according to the reaction

$$2\,NOCl(g) \rightleftharpoons 2\,NO(g) + Cl_2(g) \quad K_c = ?$$

If the equilibrium concentrations are [NOCl] = 0.80 M, [NO] = 0.28 M, and [Cl$_2$] = 0.14 M, what is the value of K_c at 800 °C?

    A. $K_c = 1.7 \times 10^{-2}$
    B. $K_c = 4.3 \times 10^{-2}$
    C. $K_c = 1.5 \times 10^{-4}$
    D. $K_c = 2.5 \times 10^{-1}$

A reaction vessel is charged with $N_2O_4(g)$ at 500 K and allowed to come to equilibrium according to the reaction

$$N_2O_4(g) \rightleftharpoons 2\ NO_2(g) \quad K_c = 0.52 \text{ at } 500 \text{ K}$$
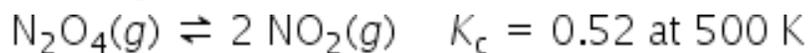
If the equilibrium concentration of $[N_2O_4]$ = 0.22 M, what is the concentration of NO_2 at 500 K?

A. 0.13 M
B. 0.20 M
C. 0.42 M
D. 0.34 M

For the reaction

$$N_2(g) + O_2(g) + Br_2(g) \rightleftharpoons 2\ NOBr(g)$$

at equilibrium at a fixed temperature, which of the following is **true**?

A. Increasing the volume causes the reaction to shift to the right (products).
B. Decreasing the volume causes the reaction to shift to the right (products).
C. Increasing the pressure of O_2 causes the pressure of N_2 to increase.
D. Addition of an inert gas causes the reaction to shift to the left (reactants).

Reaction 1: $PH_3(g) + HI(g) \rightarrow PH_4I(s)$
Reaction 2: $NaOH(aq) + H_2S(aq) \rightarrow NaSH(aq) + H_2O(l)$
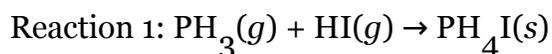
Reaction 1 is best described by the ____ theory; ____ is the base and ___ is the acid.

Reaction 2 is best described by the ____ theory; ____ is the base and ___ is the acid.

A. Brønsted-Lowry; PH3; HI
   Arrhenius; NaOH; H_2S
B. Arrhenius; PH_3; HI

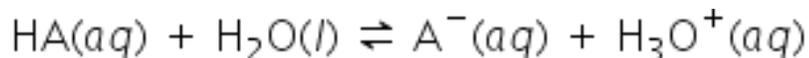   Brønsted-Lowry; NaOH; H_2S
C. Brønsted-Lowry; HI; PH_3
   Arrhenius; NaOH; H_2S
D. Arrhenius theory; PH_3; HI

   Brønsted-Lowry; H_2S; NaOH

Question #: 25

Considering the general acid equilibrium reaction with the equilibrium constant K_a,

$$HA(aq) + H_2O(l) \rightleftharpoons A^-(aq) + H_3O^+(aq)$$

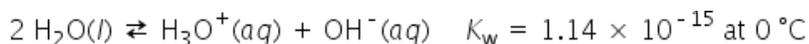A. if HA is a weak acid, A– is pH-neutral.
B. if HA is a weak acid, A– is a strong conjugate base.
C. if HA is a strong acid, A^- is a strong conjugate base.
D. a large value of K_a indicates that HA is weak.

Question #: 26

Calculate the pH of **pure water** at 0 °C and report it to **two** places to the right of the decimal point: _____

$$2\,H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \quad K_w = 1.14 \times 10^{-15} \text{ at } 0\,°C$$

Answer Key:

1. B, C
2. B
3. D
4. A
5. D
6. 1. Critical   2. Solid   3. Vaporization
7. A
8. D
9. C
10. D
11. D
12. C
13. C
14. B
15. "2"
16. D
17. B
18. B
19. B
20. A
21. A
22. D
23. B
24. A
25. B
26. "7.47"